JPL lidar multiwavelength correlative measurements during LITE overpasses of Southern California

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ABSTRACT

Contemporaneous visible, near-infrared, and mid-infrared lidar measurements of atmospheric backscatter were conducted during overpasses of the LITE (Lidar In-space Technology Experiment) Shuttle-borne lidar. This paper will describe the correlative findings determined through intercomparison of these datasets.

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The Lidar In-space Technology Experiment (LITE)[1,2] was launched aboard the Space Shuttle Discovery on mission STS-64 at 22:23 UTC, Sept. 9, 1994. Over the ensuing 10-day period the LITE instrument accumulated 53 hours of 10-see, averaged backscatter data within a few degrees of nadir at three wavelengths: 3S3, 532, and 1064 nm. The vertical resolution was 35 m and the transmit beam footprint diameter at the earth's surface was 300 m, with an orbit inclination of 57°. The launch ensured night conditions for conjunction with most of the ground stations which supported the correlative measurement program. As part of this correlative program the Jet Propulsion Laboratory (JPL) operated two lidar systems coincident with predicted LITE overpass events. A brief description of the two systems follows.

Regular measurements of atmospheric backscatter at CO_2 laser wavelengths from the air column above Pasadena, Calif. (340,2 N; 1180.2 W) were begun in late 1983 and have continued up to the present day[3]. A 10-year dataset is now available which has contributed greatly to the characterization of the aerosol backscatter climatology above the lidar site[1]. The system used for this work is a pulsed CO_2 lidar with coherent detection of the atmospheric return; it was operated during all 14 (lo nighttime, 4 daytime; see Table 1) overpasses identified as correlative opportunities by the LITE Project. The operating wavelength for these measurements was 10.6 μm.

In 1986, JPL developed a stratospheric ozone DIAL at the Table Mountain Facility (34°.4; 1170.7 W) to have characteristics suitable for long-term measurements as proposed for the

Orbit	Lighting	UTC	Data Pas.	Data TMF	Comments
24	Night	254/09:13:07	√	√	
34	Day	254/23:46:04	√		
35	Day	255/01:1 9:45	√		
40	Night	255/09:09:16	√	√	
55	Night	256/07:32:37	√	√	
56	Night	256/09:05:09	√	√	
66	Day	256/23:35:06	√		
71	Night	257/07:27:08	√	√	
72	Night	257/09:01 :12	√	√	
82	Day	257/23:29:21	√		
87	Night	258/07:21:12	√	√	
103	Night	259/07:13:56	√	√	
119	Night	260/07:03: 14	√	√	Cirrus layering 10-12 km MSL
135	Night	261/06:53:50	√	√	Thick cloud cover ~8 km MSL

Table 1. Data summary for the JPL/LITE correlative opportunities.

international Network for Detection of Stratospheric Change (NDSC). To more comprehensively study the atmospheric ozone budget, tropospheric ozone profiles were to be made using a second DIAL employing the Nd:YAG fourth harmonic at 266 nm[4]. The required precision of the ozone measurements necessitate a knowledge of the aerosol scattering also. Thus, since July 1991 aerosol backscatter profiles have been acquired. at the Nd:YAG fundamental and second harmonic wavelengths (1064 and 532 nm, respectively).

The critical system parameters for the lidars described above can be found in Table 2.

	Pasadena	Table Mountain
Lidar wavelength	10.6 μm	532 nm, 1064 nm
Range resolution (m)	200	75
integration time (reins.)	70	15
Pulse repetition rate (Hz)	0,07	10

Table 2. Salient operating parameters of the WL lidar systems.

Due to the 51.5 km separation of the two ground-based lidar stations and the fact that the LITE groundtrack seldom passed within a few km of either lidar site, as well as the differing characteristics of the lidar systems, care must be exercised in the analysis of intercomparison

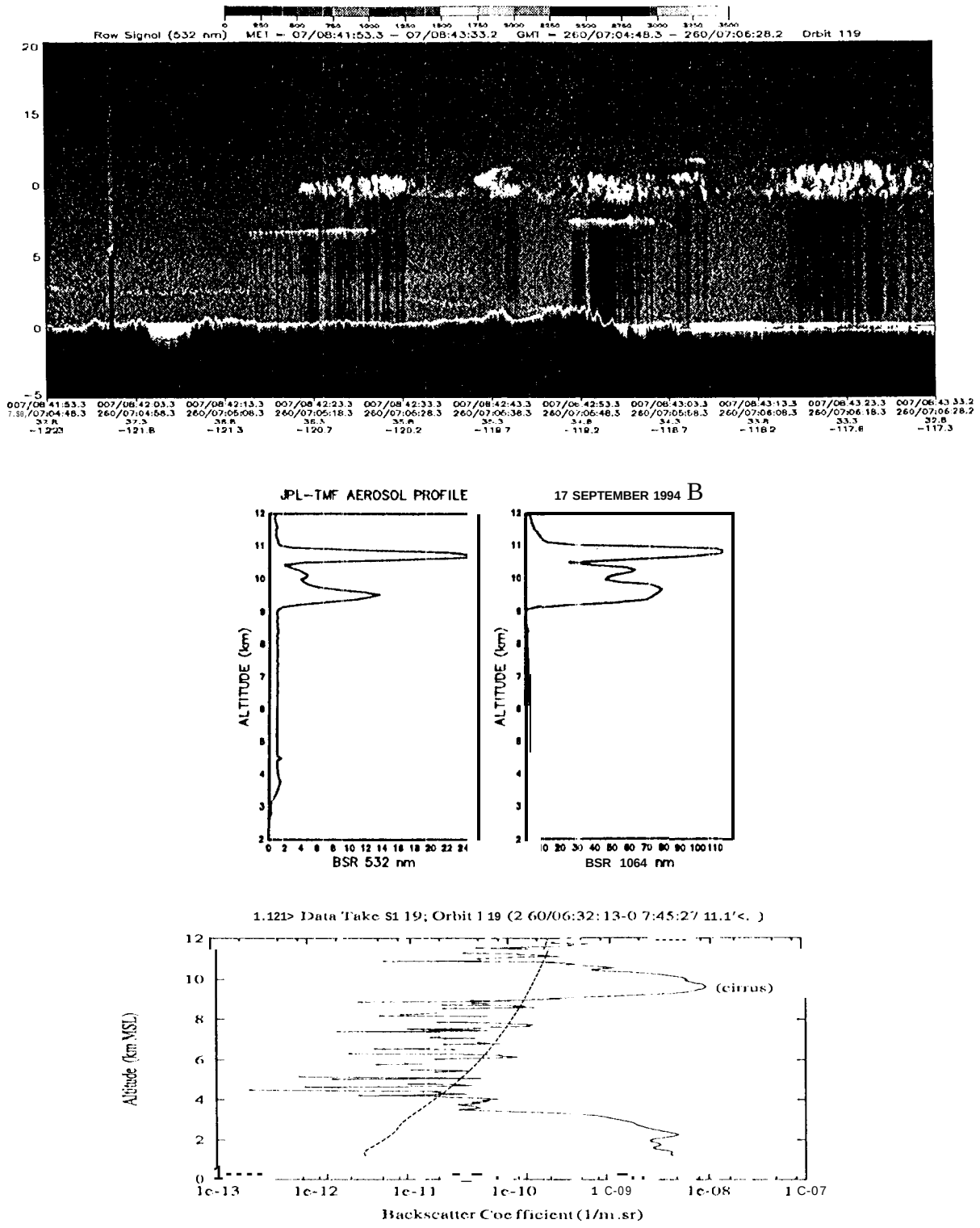

Figure 1. Correlative overview for LITE orbit 119. Top: LITE gray-scale time series back scatter; Center: JPL-TMF 532 nm and 1064 nm back scatter ratios; Bottom: JPL-Pasadena 10,6 μm backscatter coefficient,

data (see Figure 1 for a sample set of correlated data). This intercomparison exercise will bring together LITE data, lidar data from both JPL-Pasadena and JPL-TMF facilities, available meteorological data and GOES satellite imagery.

For the majority of the correlative measurement intervals atmospheric conditions were stable and cloudless, which should greatly aid intercomparison of the two geographically separated JPL lidar datasets. The final two opportunities (see Table 1), however, were beset by cloud cover, the density of which was variable during the experiment timeframe. In these instances, GOES imagery and ancillary meteorological data will be applied in assessing to what extent any correlative intercomparison is valid.

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